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## Neural avalanches at the edge-of-chaos?

Kanders, K ; Stoop, R

**Abstract:** Does the brain operate at criticality, to optimize neural computation? Literature uses different fingerprints of criticality in neural networks, leaving the relationship between them mostly unclear. Here, we compare two specific signatures of criticality, and ask whether they refer to observables at the same critical point, or to two differing phase transitions. Using a recurrent spiking neural network, we demonstrate that avalanche criticality does not necessarily lie at edge-of-chaos.

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New Welcity Yugawara,  
Yugawara, Japan

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**2016 International Symposium on  
Nonlinear Theory and its Applications**

New Welcity Yugawara,  
Yugawara, Japan  
November 27–30, 2016

**Organizer:**  
NOLTA Society, IEICE

**In Cooperation with:**  
Technical Group on Nonlinear Problems, IEICE  
Technical Group on Complex Communication Sciences, IEICE

# Welcome Message from the General Chair

Welcome to Yugawara, Japan!!

On behalf of the organizing committee, we sincerely welcome all of you to Yugawara, Japan and to the 2016 International Symposium on Nonlinear Theory and Its Applications (NOLTA2016). This is the 26th NOLTA Symposium organized by the NOLTA Society, IEICE. Since the 1st NOLTA in 1991, NOLTA has been held not only in Japan, but also in various places: Canada, China, Germany, Hungary, Italy, Poland, Spain, Switzerland, and USA. Then, it is our great honor to organize the NOLTA2016 in Yugawara, Japan.

A long long time ago, a badly injured mountain animal was walking along the riverside, and by chance discovered a hot spring near the cold mountain stream. The serious injury of the animal healed rapidly by the hot spring. The riverside ("kawara" in Japanese) which flows from that magical hot spring ("yu" in Japanese) came to be called Yugawara. Today, Yugawara is one of the oldest hot spring villages in Japan, the place where the mountain animals told us of the secret power of the hot spring.

Please have fun while in Yugawara, nestled by the mountains and the sea, and enjoy the brilliant blue sea and the green mountains. You can enjoy an open-air bath, a quiet room for relaxation, and other services.

The word Yugawara can also be found in the oldest Japanese anthology of poems, "Manyoshu," published about 1,200 years ago. Many famous Japanese poets and writers love Yugawara and have created wonderful stories there throughout the hot spring's very long history. We support your creative activities by providing the hot spring and various types of conference rooms. Yugawara also benefits from both the mountains and sea, which enable us to provide fresh seasonal food.

The most essential aspect of NOLTA2016 is its technical program. In particular, we have a large number of special session papers at NOLTA2016. We also have a large number of regular session papers, and we are also proud to present the best student paper awards at NOLTA2016.

I would like to thank the Technical Program Chairs, Prof. Hiroo Sekiya (Chiba University) and the Technical Program Secretary, Prof. Shintaro Arai (Okayama University of Science), who have organized a high-quality technical program spanning three days of lecture sessions that cover all subjects of interest in the field of nonlinear science and engineering. We also would like to thank to the efforts of our Special Session Chair, Prof. Mikio Hasegawa (Tokyo University of Science), and the Special Session Secretary, Dr. Kaori Kuroda (Tokyo University of Science), for organizing such a huge number of special sessions.

Special thanks also go to the Technical Program Committee Members and reviewers for their dedicated service. We would also like to thank the keynote speakers and session co-chairs for their great contributions to the technical program.

Finally, we would like to express our sincere thanks to General Co-Secretaries, Prof. Takayuki Kimura (Nippon Institute of Technology) and Dr. Yutaka Shimada (Tokyo University of Science) and all the symposium committee members of NOLTA 2016.

We hope you will enjoy NOLTA2016 and Yugawara!



Tohru Ikeguchi  
Tokyo University of Science  
General Chair, NOLTA2016

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# Technical Program Chair's Message

On behalf of the Technical Program Committee (TPC), welcome to 2016 International Symposium on Nonlinear Theory and Its Applications (NOLTA2016) at Yugawara, where is one of the most famous hot-spring resort in Japan!

A total of 212 papers have been received from 15 countries and 208 papers are included for presentations in the technical program. We have 38 oral sessions including 30 special sessions. Additionally, it is my pleasure to have two exciting Plenary Talks: “Math Spectacle Show” by Prof. Jin Akiyama, Tokyo University of Science on Monday, and “Almighty Google knows everything! – Big-data and Network Science” by Prof. Hawoong Jeong, Korea Advanced Institute of Science and Technology (KAIST) on Tuesday.

Our program can cover hot topics in variety of research areas, which gather under the term of ‘Nonlinear’. I would like to express my appreciation for all authors who submitted papers to NOLTA 2016. It is one of the traditional features of the technical programs in NOLTA that many special sessions are organized by leading researchers. The special sessions from wide research areas may raise new collaborations among symposium participants, which is quite important for succeeding NOLTA2016. I would like to express my thanks to the special session organizers and presenters. In addition, organizing and coordinating of NOLTA2016 are impossible without contributions and services of review committee members, reviewers, and session co-chairs. I am also equally thankful for Tom Wehner’s support of web-based services.

The poster area appears for finding NOLTA2016 student paper award winners, which is the first trial in NOLTA history. All the participants including students have a right to recommend the award-winner candidates. Please visit the poster area, discuss with students, and vote the award-winner candidates.

Finally, I would like to announce the Special Section related with NOLTA2016, which will be published in NOLTA. IEICE at January 2018. The paper submission dead line is April 10, 2017. I hope that all authors, especially students, consider to submit the extended version of papers in this program to the Special Section.

I really hope participants to attend as many activities as possible, exchange and discuss ideas, enjoy the technical program and NOLTA2016!



Hiroo Sekiya  
Chiba University  
Technical Program Chair, NOLTA2016

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# Special Session Organizers

**A2L-C** Time series and complex networks (1)

**A3L-C** Time series and complex networks (2)

**Organizers** Michael Small (University of Western Australia) and Yoshito Hirata (University of Tokyo)

**A2L-E** Electromechanical systems

**Organizers** Hiroyuki Asahara (Okayama University of Science)

**A2L-F** Power packet: Energy-and-Information integrated technology (1)

**A3L-F** Power packet: Energy-and-Information integrated technology (2)

**Organizers** Hiroyasu Ando (University of Tsukuba) and Ryo Takahashi (Kyoto University)

**A2L-G** Radio Frequency Technology

**Organizers** Takeshi Kamio (Hiroshima City University) and Hisato Fujisaka (Hiroshima City University)

**A3L-B** Nonlinear Methods with Interaction

**Organizers** Tomoya Suzuki (Ibaraki University)

**A3L-D** Hybrid dynamical systems: Modeling, Analysis, and Applications

**Organizers** Daisuke Ito (University of Shiga Prefecture)

**A3L-G** Implementation technology and theory for neuronal and neuronal network models

**Organizers** Takashi Kohno (University of Tokyo)

**A4L-C** Random Number Generation and Chaos

**Organizers** Hiroshi Fujisaki (Kanazawa University)

**A4L-D** Collective behaviors of chemically/electrically coupled neurons

**Organizers** Ryosuke Hosaka (Fukuoka University) Kantaro Fujiwara (Tokyo University of Science) and Hideyuki Kato (Tokyo University of Technology)

**A4L-E** Complex Communication Sciences

**Organizers** Mikio Hasegawa (Tokyo University of Science)

**A4L-F** Simulations in Cardiovascular Systems

**Organizers** Hiroyuki Kitajima (Kagawa University) and Kunichika Tsumoto (Osaka University)

**B2L-B** Koopman operator techniques in nonlinear dynamical systems

**Organizers** Yoshihiko Susuki (Kyoto University) and Igor Mezic (University of California)

**B2L-C** Coupled Nonlinear Circuits and Networks (1)

**B3L-C** Coupled Nonlinear Circuits and Networks (2)

**C1L-C** Coupled Nonlinear Circuits and Networks (3)

**Organizers** Yoko Uwate (Tokushima University) and Yoshifumi Nishio (Tokushima University)

**B2L-D** Noise-Driven and Stochastic Information Processing Systems

**Organizers** Tetsuya Asai (Hokkaido University) and Shintaro Arai (Okayama University of Science)

**B2L-F** Recent Progress in Nonlinear Optimization Algorithms and its Applications (1)

**B3L-F** Recent Progress in Nonlinear Optimization Algorithms and its Applications (2)

**Organizers** Hidehiro Nakano (Tokyo City University) and Takuya Shindo (Nippon Institute of Technology)

**B3L-B** Complex Photonics and Applications (1)

**C1L-B** Complex Photonics and Applications (2)

**C2L-B** Complex Photonics and Applications (3)

**Organizers** Kazutaka Kanno (Fukuoka University) and Atsushi Uchida (Saitama University)

**B3L-D** Synchronization in real worlds and its mathematical modeling

**Organizers** Tohru Ikeguchi (Tokyo University of Science) and Yutaka Shimada (Tokyo University of Science)

**B3L-E** AD Converters and Dynamical Systems

**Organizers** Yutaka Jitsumatsu (Kyushu University) and Katsutoshi Shinohara (Hitotsubashi University)

**C1L-D** Localization phenomena in nonlinear lattices (1)

**C2L-D** Localization phenomena in nonlinear lattices (2)

**Organizers** Masayuki Sato (Kanazawa University) and Masayuki Kimura (Kyoto University)

**C1L-F** Cellular Dynamical Systems

**Organizers** Hiroyuki Torikai (Kyoto Sangyo University)

**C2L-E** Applications to Temporal Nonlinear Systems

**Organizers** Tomoya Suzuki (Ibaraki University)

**C2L-F** Information Networks as Collective Statistical Systems

**Organizers** Hiroyoshi Miwa (Kwansei Gakuin University)

# Symposium Information

## Symposium Venue

New Welcity Yugawara  
107 Izumi, Atami-city, Shizuoka, Japan

[Opening Ceremony & Plenary Talks]  
Hall TAIKAN on Floor 2

[Parallel Sessions]  
Six rooms on Floors 1, 2 & 3

[Poster Session, presented by Award candidates]  
Lobby on Floor 2

## Symposium Registration

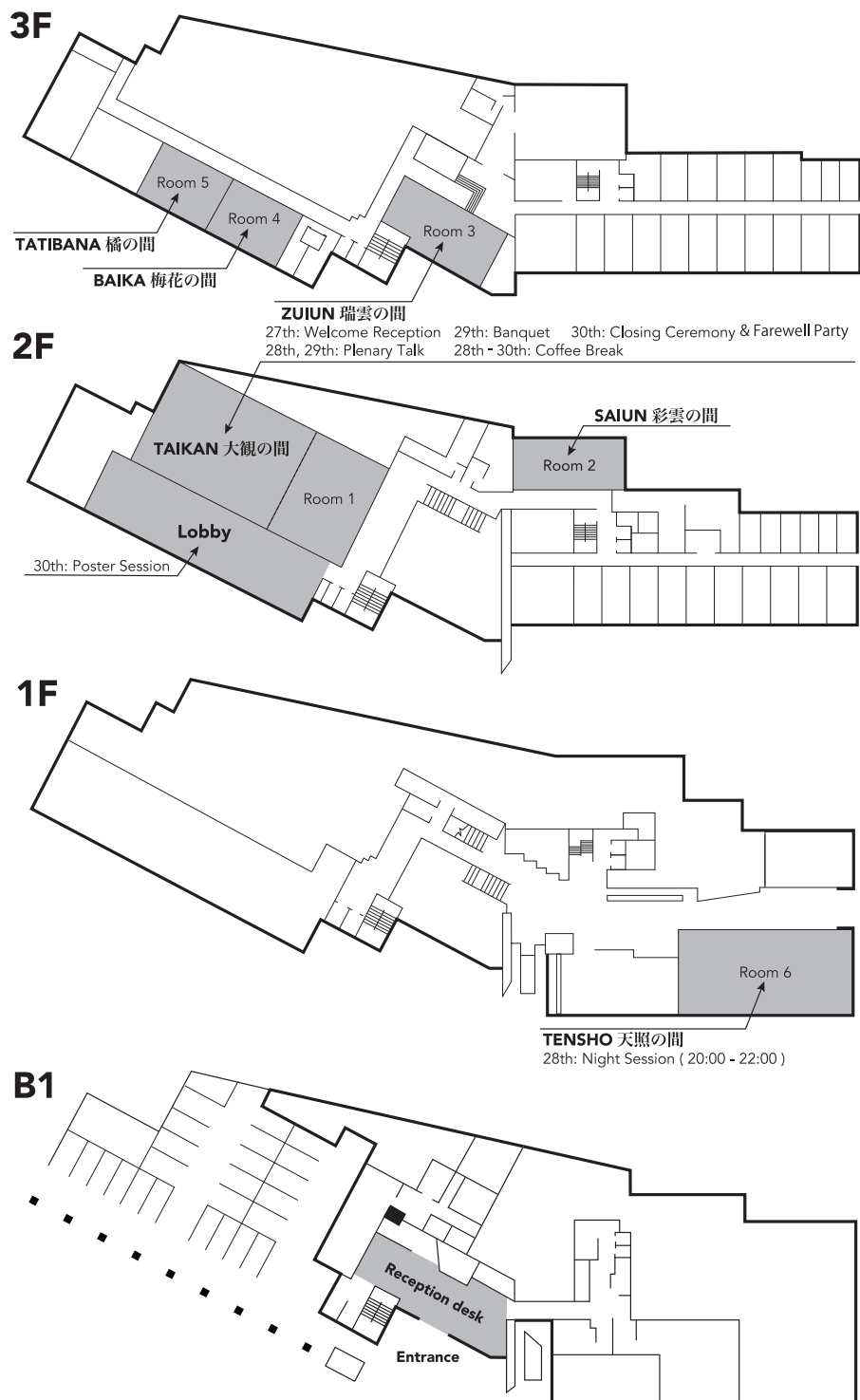
Nov. 27, 16:30 – 19:30 on the Floor B1, New Welcity Yugawara  
Nov. 28, 8:15 – 18:30 on the Floor B1, New Welcity Yugawara  
Nov. 29, 8:30 – 17:00 on the Floor B1, New Welcity Yugawara  
Nov. 30, 8:30 – 14:30 on the Floor B1, New Welcity Yugawara

## Social Events

- Nov. 27, 18:00 – 19:30, Welcome reception: Hall TAIKAN
- Nov. 29, 19:00 – 21:00, Banquet: Hall TAIKAN
- Nov. 30, 15:30 – 17:00, Farewell party and Student paper award ceremony: Hall TAIKAN

## Session Room Information

Hall	TAIKAN on Floor 2	Room 2	SAIUN on Floor 2
Room 1	TAIKAN on Floor 2	Room 4	BAIKA on Floor 3
Room 3	ZUIUN on Floor 3	Room 6	TENSHO on Floor 1
Room 5	TATIBANA on Floor 3		



Session room

# Session at a Glance

November 28, 2016 (Monday)

	New Welcity Yugawara					
9:00–9:10	Opening ceremony Place: Hall TAIKAN					
9:10–10:10	Plenary Talk 1, Prof. Jin Akiyama (Tokyo University of Science, Japan) Chair: Tohru Ikeguchi (Tokyo University of Science) Place: Hall TAIKAN					
10:10–10:30	Coffee break					
	Room 1	Room 2	Room 3	Room 4	Room 5	Room 6
10:30–12:30	A2L-B Chaos and Bifurcation 1 Chairs: Kyohei Kamiyama and Marco Reit Page <a href="#">xviii</a>	A2L-C Special Session: Time Series and Complex Networks 1 Chair: Michael Small Page <a href="#">xix</a>	A2L-D Neural Networks and Optimization Chair: Hiroyuki Yasuda Page <a href="#">xix</a>	A2L-E Special Session: Electromechanical Systems Chair: Hiroyuki Asahara Page <a href="#">xx</a>	A2L-F Special Session: Power Packet: Energy-and-Information Integrated Technology 1 Chair: Hiroyasu Ando Page <a href="#">xxi</a>	A2L-G Special Session: Radio Frequency Technology Chairs: Takeshi Kamio and Hisato Fujisaka Page <a href="#">xxi</a>
12:30–13:50	Lunch break					
13:50–15:30	A3L-B Special Session: Nonlinear Methods with Interaction Chair: Tomoya Suzuki Page <a href="#">xxii</a>	A3L-C Special Session: Time Series and Complex Networks 2 Chair: Yoshito Hirata Page <a href="#">xxii</a>	A3L-D Special Session: Hybrid Dynamical Systems: Modeling, Analysis, and Applications Chair: Daisuke Ito Page <a href="#">xxiii</a>	A3L-E Control and Robotics Chairs: Keiji Konishi and Yoshiaki Sugitani Page <a href="#">xxiv</a>	A3L-F Special Session: Power Packet: Energy-and-Information Integrated Technology 2 Chair: Ryo Takahashi Page <a href="#">xxiv</a>	A3L-G Special Session: Implementation Technology and Theory for Neuronal and Neuronal Network Models Chairs: Kazuyuki Aihara and Takashi Kohno Page <a href="#">xxv</a>
15:30–15:50	Coffee break					
15:50–18:30	A4L-B Chaos and Bifurcation 2 Chairs: Yusuke Matsuoka and Martin Schüle Page <a href="#">xxv</a>	A4L-C Special Session: Random Number Generation and Chaos Chair: Hiroshi Fujisaki Page <a href="#">xxvi</a>	A4L-D Special Session: Collective Behaviors of Chemically/Electrically Coupled Neurons Chair: Ryosuke Hosaka Page <a href="#">xxvii</a>	A4L-E Special Session: Complex Communication Sciences Chairs: Mikio Hasegawa and Hidehiro Nakano Page <a href="#">xxvii</a>	A4L-F Special Session: Simulations in Cardiovascular Systems Chairs: Hiroyuki Kitajima and Kunichika Tsumoto Page <a href="#">xxviii</a>	A4L-G Synchronization Chair: Kuniyasu Shimizu Page <a href="#">xxix</a>



## November 29, 2016 (Tuesday)

	New Welcity Yugawara					
9:00–10:00	Plenary Talk 2, Prof. Hawoong Jeong (Korea Advanced Institute of Science and Technology, Korea) Chair: Hiroo Sekiya (Chiba University) Place: Hall TAIKAN					
10:00–10:20	Coffee break					
	Room 1	Room 2	Room 3	Room 4	Room 5	Room 6
10:20–12:40	B2L-B Special Session: Koopman Operator Techniques in Nonlinear Dynamical Systems Chair: Yoshihiko Susuki Page <a href="#">xxx</a>	B2L-C Special Session: Coupled Nonlinear Circuits and Networks 1 Chair: Yoko Uwate Page <a href="#">xxxi</a>	B2L-D Special Session: Noise-Driven and Stochastic Information Processing Systems Chairs: Tetsuya Asai and Shintaro Arai Page <a href="#">xxxi</a>	B2L-E Communication Systems and Signal Processing Chairs: Francis C.M. Lau and Yuko Osana Page <a href="#">xxxii</a>	B2L-F Special Session: Recent Progress in Nonlinear Optimization Algorithms and its Applications 1 Chair: Hidehiro Nakano Page <a href="#">xxxiii</a>	
12:40–14:00	Lunch break					
14:00–16:00	B3L-B Special Session: Complex Photonics and Applications 1 -Random Number Generation- Chair: Atsushi Uchida Page <a href="#">xxxiv</a>	B3L-C Special Session: Coupled Nonlinear Circuits and Networks 2 Chair: Thomas Ott Page <a href="#">xxxiv</a>	B3L-D Special Session: Synchronization in Real Worlds and its Mathematical Modeling Chairs: Tohru Ikeguchi and Yutaka Shimada Page <a href="#">xxxv</a>	B3L-E Special Session: AD Converters and Dynamical Systems Chair: Yutaka Jitsumatsu Page <a href="#">xxxvi</a>	B3L-F Special Session: Recent Progress in Nonlinear Optimization Algorithms and its Applications 2 Chair: Takuya Shindo Page <a href="#">xxxvi</a>	
19:00–21:00	Banquet Place: Hall TAIKAN					

## November 30, 2016 (Wednesday)

	New Welcity Yugawara					
9:00– 10:15	Poster Session, presented by Award candidates Place: Lobby on Floor 2					
10:15– 10:30	Coffee break					
	Room 1	Room 2	Room 3	Room 4	Room 5	Room 6
10:30– 12:30	C1L-B Special Session: Complex Photonics and Applications 2 -Photonic integrated circuits- Chair: Kazutaka Kanno Page <a href="#">xxxvii</a>	C1L-C Special Session: Coupled Nonlinear Circuits and Networks 3 Chair: Kyohei Kamiyama Page <a href="#">xxxviii</a>	C1L-D Special Session: Localization Phenomena in Nonlinear Lattices 1 Chair: Masayuki Kimura Page <a href="#">xxxviii</a>	C1L-E Complex Networks and Systems Chair: Michael Small Page <a href="#">xxxix</a>	C1L-F Special Session: Cellular Dynamical Systems Chair: Hiroyuki Torikai Page <a href="#">xxxix</a>	
12:30– 13:50	Lunch break					
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ROOM: Hall

Chair: Tohru Ikeguchi (Tokyo University of Science)

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DATE: 2016/11/28 13:50–15:30

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# B2L-D Special Session: Noise-Driven and Stochastic Information Processing Systems

DATE: 2016/11/29 10:20–12:40

ROOM: Room 3

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ROOM: Room 4

Chairs: Francis C.M. Lau (Hong Kong Polytechnic University) and Yuko Osana (Tokyo University of Technology)

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DATE: 2016/11/29 14:00–16:00

ROOM: Room 1

Chair: Atsushi Uchida (Saitama University)

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DATE: 2016/11/29 14:00–16:00

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ROOM: Room 4

Chair: Yutaka Jitsumatsu (Kyushu University)

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- B3L-E2 Pseudo Random Numbers Generated by Dynamical Systems** 518  
Makoto Mori (Nihon University)
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ROOM: Room 5

Chair: Takuya Shindo (Nippon Institute of Technology)

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DATE: 2016/11/30 10:30–12:30

ROOM: Room 1

Chair: Kazutaka Kanno (Fukuoka University)

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## C1L-C Special Session: Coupled Nonlinear Circuits and Networks 3

DATE: 2016/11/30 10:30–12:30

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- C1L-C3** **Synchronization in Dynamical Polygonal Oscillatory Networks with Switching Topology** 578

Yoko Uwate (Tokushima University), Yoshifumi Nishio (Tokushima University), Ruedi Stoop (Universität Zürich / Eidgenössische Technische Hochschule Zürich)

- C1L-C4** **Review of Tuned Power Oscillators** 582

Hiroo Sekiya (Chiba University)

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ROOM: Room 3

Chair: Masayuki Kimura (Kyoto University)

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- C1L-D4** **Tunable Wave Propagation in Mechanical Metamaterials Made of Triangulated Cylindrical Origami** 596

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ROOM: Room 4

Chair: Michael Small (University of Western Australia)

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DATE: 2016/11/30 10:30–12:30

ROOM: Room 5

Chair: Hiroyuki Torikai (Kyoto Sangyo University)

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DATE: 2016/11/30 13:50–15:30

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